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OIL REFINERY DEVELOPMENT
IN
MASSACHUSETTS

Draft May 1976

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INTRODUCTION

Oil refineries have become an important and controversial issue in Massachusetts as well as throughout New England. Since 1968 over a dozen major proposals for petroleum terminaling and/or refinery projects have been put forth, some of which are still pending. These proposals have often been supported by claims that New England "needs" oil refineries and the jobs and industrial growth that can accompany them. Proposals have also been condemned by opponents who claim that refineries are unnecessary and would cause significant damage to the state's tourism and fishing industries and to its high quality environment which is an important factor in the siting decisions of firms that develop and locate in the state. The purpose of this paper is to analyze potential oil refinery development in Massachusetts in order to put the issue into perspective. The paper is presented in four sections. The first section discusses background issues affecting oil refinery development in Massachusetts. The second section discusses the economic impacts of a hypothetical Massachusetts refinery. The third section discusses the environmental impacts of a hypothetical Massachusetts refinery. The final section discusses policy implications for Massachusetts pertaining to oil refinery development.

wrong employment will be scarces

BACKGROUND ISSUES FOR OIL REFINERY DEVELOPMENT

The potential for Massachusetts oil refinery development must be evaluated in terms of both the national and regional setting. Through 1950, the United States was totally energy self-sufficient and met its growing thirst for energy with cheap and abundant domestic fuels. But by 1960, imports of crude oil

and petroleum products accounted for 15 percent of total domestic consumption, and by 1973 imports had jumped to 35 percent.[1/] The growing dependence upon foreign oil was the result of increasing demand, cheap imports, and a steadily deteriorating domestic supply situation.

As domestic production declined, the nation became more and more dependent upon distant sources of crude such as the Persian Gulf. Given the trends of increasing demand, and increasing emphasis on distant foreign sources of crude, coastal areas such as New England, which were completely dependent upon other regions for refined products, became somewhat attractive sites for the development of new refinery capacity.

In 1972 New England consumed 5.2 billion gallons of gasoline, 127 million gallons of distillate, and 156 million gallons of residual fuel oil per year.[2/] The daily consumption was 1.13 million barrels per day for 1973.[3/] Using a 250,000 barrel per day refinery it would take at least four refineries to supply New England's petroleum needs.

A new refinery operating in New England would have had approximately the same crude transportation costs as similar new refinery in the Mid Atlantic Region (and slightly lower costs than a similar new refinery in the Gulf of Mexico region) but would have a considerable product transportation cost advantage over refineries in the other regions serving New England markets. A 1973 study prepared for the Massachusetts Port Authority estimated the cost advantage to a hypothetical New England refinery to be $.50 per barrel of oil.[4/] When compared to the $3 per barrel 1973 price of crude oil, the $.50 per barrel potential cost saving was significant and probably provided much of the impetus for the proposals to construct New England refineries.

The world petroleum situation changed dramatically in October 1973 as a result of the Arab oil embargo. By January 1974, U.S. oil imports were down by 2.7 million barrels per day, reducing supply by more than 14 percent below expected consumption and prices had risen from $3 per barrel to over $11.[5/] The embargo had a dramatic impact on the U.S. economy. The Federal Energy Administration estimated that the embargo was responsible for a decline in GNP of between 10 and 20 billion dollars, the unemployment of 500,000 workers, and one-third of the 9.8 percent increase in consumer prices that occurred during the embargo.[6/]

The oil embargo caused the federal government to rethink its energy policies. A primary goal was to reduce the nation's vulnerability to future embargoes. Several strategies were suggested in the final report of Project Independence, published in November 1974, the result of an interagency task force led by the Federal Energy Administration. As a means of reducing imports, the study suggested several methods of accelerating domestic energy production and conserving petroleum. It also suggested several emergency preparedness programs that would reduce vulnerability to future interruptions of crude supply.

The ability of federal policies to reduce demand for foreign oil is of critical importance to Massachusetts. At the present time, it is impossible to determine how effective government policies will be in reducing demand for foreign oil. In fact, the policies themselves have not yet been determined. There has been talk concerning the possiblity of an absolute limitation on the amount of oil imported, or an absolute limitation on the number of dollars paid for imports.[7/] Difficulty in predicting availability of crude has been a major obstacle to the planning of grass roots refineries and expansion of existing facilities. The financing of refinery expansion would be very difficult

without some kind of assurance that actions taken by the federal government would not result in the limitation of crude supplies. This kind of assurance does not seem to be consistent with the programs and solutions being considered at the federal level.

Other uncertainties arise from the acceleration of the Outer Continental Shelf oil and gas exploration and development program. Although the leasing mechanism has been set in motion from frontier areas on the Atlantic Coast and Gulf of Alaska, it will still be a number of years before it is possible to determine the magnitude of oil and gas resources. Until the geologic work and preliminary drilling is done on the Outer Continental Shelf, it will be very difficult to come to grips with the question of how much domestic refinery capacity is actually going to be needed.

Oil from potential development of Georges Bank has been looked upon by some people as a means of establishing a secure supply of crude for a Massachusetts or New England refinery. This has been disputed by a number of experts. One study stated that even a very large 2 billion barrel recoverable find could supply the entire New England market of 1.2 million barrels per day for at most two or three peak years.[8/] This implies that either the bulk of Georges Bank crude drilling peak production years will have to go to non-New England refineries or that any New England refinery will have to be prepared to refine non-Georges Bank crude for the greater part of its life. As far as most potential offshore oil developers are concerned, it makes more sense to transport Georges Bank oil the somewhat further distance to refineries in the Mid-Atlantic regions which are currently running below full capacity than to transport the oil to New England where new refineries would have to be built. Furthermore, if Mid-Atlantic refinery capacity is insufficient to accommodate oil from development of the Atlantic OCS, it would

still be less expensive to expand capacity at existing refineries than it would be to construct a new refinery from the bottom up. Also, some experts have stated that there is a better than even chance that there will be no commercially exploitable petroleum at all on Georges Bank.

Finally one factor which will influence the ability to refine Georges Bank oil is whether it will be sour (high sulfur content) or sweet (low sulfur). If it is sour, it will have to be mixed with imported sweet oil.

There are some circumstances that could favor oil refinery development in Massachusetts or in New England. If the federal government decided that the nation was going to import foreign oil and established an independent refiner to construct a facility in the region. At this time however, it is difficult to determine what events will occur in the world and national oil markets.

THE ECONOMIC IMPACTS OF A REFINERY

It is impossible to evaluate precisely the impacts of a refinery without site specific information since the magnitude of the benefits and costs depend on the size of the facility, its location, the product mix of its output, and the impact of federal, state and local regulations. It is possible however, to provide reasonable estimates for some of the impacts based on a number of assumptions. The estimates made in this paper will be based on a 250,000 barrel per day facility that would produce a product mix similar to the demand mix for the region (i.e. a high fuel oil percentage as opposed to a high gasoline percentage). The estimates are derived from a number of recent studies on oil refineries in the region.[10/]

Employment and Income

Employment and income impacts are broken into two phases, construction and operation. For the construction phase, direct employment would be 1800,

indirect employment* 182, and induced@ employment 1,045 per year for a three year period and total wages for the construction period would be $49,055,000 per year.[11/] The net impact of employment and income to Massachusetts would be less because of the opportunity costs of labor and because many of the specialized skills required for construction activities would have to be brought in from the outside. The operations phase of the refinery would have direct employment of only 410 people, indirect employment of 735 and induced employment of 330 with total wages of $15,509,000.[12/] The A.D. Little report for the New England Regional Commission projected that 30 percent of all the construction jobs and 11 to 14 percent of all refinery jobs would accrue to people relocating in the region.

Public Sector Impacts

Public sector impacts of oil refineries would vary tremendously according to the individual community involved and its public infrastructure. Approximately 20 percent of the total construction cost of approximately 700 million dollars would be subject to local taxation.[13/] The local spending policies and tax rates would determine the actual amount of tax revenue generated by the facility. A community could use the revenue to lower its tax rate, increase public services, or a combination of both.

A major problem with large scale industrial development such as oil refineries is that the facility impacts surrounding communities which receive

* Indirect employment is that generated in industries and services supplying the primary activity.

@ Induced employment is that created by increased consumer demand due to the increased payroll and tax levels created by the primary activity.

none of the tax revenue. The host community is compensated to some extent by the property tax generated by the development while neighboring towns must provide additional public services required as a result of the development, but derive no tax benefits. The impacts are particularly severe during the construction phase when total employment in the area increases by as much as two thousand people for a three to four year duration. Even the host community may suffer significant fiscal damage in the short term because of the fact that its needs for increased public services occur before the development starts paying the bulk of its taxes. One way to alleviate the time lag between providing services and receiving tax revenues would be for the municipalities to negotiate with the developers to receive loans prior to construction.

Refinery development could provide a boost to the state's tax base. Such development would lead to increases in the state's corporation income tax, sales tax, and income tax. Including indirect and induced taxes, state revenues could be increased by approximately 18 million dollars per year including the taxes paid by the industry and by employees associated with industrial development.[14/] Costs to the municipalities for services for development of this scale would amount to $291,000. But they caution that this figure presumes that the refinery will supply its own fire-fighting police, water and sewage needs and that it thus reflects only increased costs due to new employees-a figure which may vary greatly depending upon location.

Additional growth in a region could be stimulated by the development of a refinery. Residential development and service sector expansion can be expected to occur. There is some possibility that further industrial growth could be stimulated by such development as petrochemical plants. However,

the economics of the basic petrochemical production would require a large plant whose output would far exceed the current regional demand for petrochemicals.[15/] Furthermore, a refinery which can supply the petrochemical industry needs to be far more complex than the high fuel oil refinery described in this paper. Arthur D. Little Inc. has stated that it is unlikely that a major petrochemical development will take place in New England--at least over the next 5-10 years.

Price Considerations

It is frequently claimed that the development of a petroleum refinery in an area will reduce the price that consumers pay for oil products. Although it can be shown that a New England refinery would have a cost advantage over a similar new refinery located in other regions that were dependent upon the same distant source of crude, there is no guarantee that cost savings would be passed on to consumers. Only if enough refineries were constructed in the region to meet the entire New England petroleum demand and thus create competition within the New England market, would there be any passing on of cost savings to consumers. As long as New England depends on petroleum products imported from other regions, the price of New England refined products will remain at least as high as products from other parts of the country.

ENVIRONMENTAL IMPACTS OF A REFINERY

The environmental impacts of an oil refinery can be generalized to a limited extent since specific environmental impacts will vary greatly according to its size, method of crude receipt and product distribution, product mix, location, and design of the facility. The major types of impacts include spills from shipping and transferring the oil, air pollution, water pollution, water supply, solid waste, and land use.

Oil Spills

The use of supertankers, likely to be associated with major refinery developments, over a period of time will result in the spillage of considerable amounts of oil. The spilled oil could at times, reach shorelines and beaches and could have serious and lasting environmental effects. Large spills will be caused by groundings and collision as well as major equipment failures; more frequent spills will chiefly occur during the unloading process, and be caused by human error, mechanical failure, and accidental discharge from storage areas.

Large oil spills kill large numbers of intertidal and benthic organisms, and could have a major impact on recreational activities and tourism. The effects could last for several years and natural cleansing would be especially slow in sandy and muddy bottom sediments. The long range cumulative effect of spills, both large and small, are not well known, but are thought to be serious.

The number of oil spills is usually closely related to the number of transfer operations from ship to shore or vice versa. It is likely that the use of supertankers could reduce the frequency of spills because fewer trips and transfer operations would be required with the larger tankers. However, studies of the single point mooring deep water facility at Milford Haven, United Kingdom has shown a higher spillage rate than for conventional fixed-berth transfer facilities. Thus, the rate of oil spilled per gallons shipped should decrease with deepwater ports, but the spillage per number of vessels unloading may not. The reader should refer to another paper by the Office of Coastal Zone Management on Deep-Water Ports for further information on the environmental benefits and risks to supertanker shipment over conventional tanker shipment.

Air Pollution

By far, the most serious air pollution problems are posed by hydrocarbons; problems associated with sulfur oxides and particulates will pose some siting limitations, but a combination of wise site selection and good engineering can bring these within acceptable state and federal criteria.[17/]

92,000 pounds of hydrocarbons per day will be emitted by the refinery and 7000 pounds of hydrocarbons per day will rise from the storage tanks.[18/] A dispersion study using a hypothetical 180-MBD refinery in the Lowell area concluded that the primary air quality standard for hydrocarbons would be exceeded about 5% of the time as much as 5 miles away from the refinery, and for greater periods closer to the plant.[19/] Downwind locations over a very large geographical area could be significantly affected by hydrocarbon emissions and obnoxious odors might be noticeable up to several miles from the site.

Sulfur oxides are formed during the process of refining and desulfuring and during the combusion of fuel used in generating heat for processing crude. Daily sulfur oxide emissions will range from approximately 11 to 47 tons.[20/] Concentration will be greatest near the site and depending upon the amounts contributed by other sources, may constitute a significant annual increase in sulfur oxides levels in a given area.

Particulates would be the third air pollutant. Federal standards could be met if best available technology is used, although total particulate emmissions could range from 800 to 3500 tons per year.[21/]

Water Supply and Quality

A water cooled high fuel oil, 250,000 barrel per day refinery requires about 11.3 million gallons of water per day, (approximately equal to the water requirements of a town of 13,000 pepole) about 40% of which is consumed in the refinery processes.[22/] Water is used both for cooling and for refinery processes. Cooling water, when discharged into a water body, may cause thermal pollution which may harm aquatic species sensitive to increases in temperature and may lead to increased eutrophication of streams. Process water discharges contain toxic substances picked up in the refinery processes and must be treated before it is dumped into a water body. In order to meet environmental standards, a large, well-flushed water body is required so that concentration standards for effluents can be met. According to Arthur D. Little, only four rivers in the entire New England region are capable of supplying sufficient volumes of water. Only one of these, The Merrimack, north of Boston, is located in Massachusetts. Some smaller rivers might be utilized if they drew upon ground water and stored water. But the large volumes of wastewater discharge would have a very large impact on smaller bodies of water.

Solid Waste

Refinery processes generate a significant amount of solid and semi solid waste, some of which are considered as hazardous materials by EPA. Process water treatment produces sludge which is roughly comparable to municipal treatment plant sludge. Electrostatic precipitators produce solids by removing particulate matter from stack gasses. approximately 1 to 5 tons per day. Catalytic cracking produces solid waste by breaking down large molecules and crude desulfurization process generate approximately 564 tons of sulfur per day.[23/] Oil spill cleanup operations also may generate a substantial amount of solid waste, contributing further to solid waste disposal problems.

Land Use

A 250,000 barrel per day refinery would require a site of approximately 1000 to 1500 acres for refinery buildings, storage tanks and dikes, ancillary structures, crude receiving and product loading facilities, and buffer zones. Construction impacts could be very significant as there would be nearly two thousand workers traveling to the site each day, creating traffic problems along with the heavy construction equipment that would be mobilized at the site. Depending upon the product distribution system used by the refinery significant transportation impacts could result from the operations phase also. The extensive use of tank trucks could place a severe strain on highway systems. The refinery would induce secondary residential and commercial growth which could disrupt existing land use patterns in the community. In spite of mandated environmental controls, refineries are not pollution free. Air, water, noise, and aesthetic pollution would be noticeable in areas adjacent to the refinery complex.

As mentioned earlier, the land use impacts, though localized in a specific region, would have significant impacts outside of the community in which it is located. At the present time, there is no mechanism that insures the protection of the interest of adjacent communities.

POLICY IMPLICATIONS OF REFINERY DEVELOPMENT IN MASSACHUSETTS

Massachusetts does not "need" an oil refinery. It could continue to receive its petroleum in the same manner as it has in the past. However, there could be some advantages to the state from a refinery in the form of slightly increased employment, additional tax revenue, and slightly greater security of supply of petroleum products. (Benefits from a local refinery

in terms of security are only marginal because in the event of a long term supply disruption such as that which occurred in 1973-1974, the federal government would use an allocation program to distribute petroleum products as they did during the Arab oil embargo). The advantages of refinery development are at least partially offset by adverse environmental impacts, increased public service sector expenditures and potential decline of tourism and fishing industries.

The decision as to whether or not there should be an oil refinery in the state should be a public decision. Such a decision would need to be based on further study of the feasibility of securing a reliable source of crude, for without such a supply no refinery could be built no matter how hard the state tried to attract a developer.

If a decision to attempt to attract a refinery to Massachusetts is made, all of the state's available resources and expertise should be utilized in order to provide the state with the best possible outcome. The state should take, an active role in determining the best locations for such development, incorporating the ongoing planning efforts of state agencies.

Proper consideration should be given to both natural resource factors and the desires of local communities.

The state's promotional activity, if it decided to become involved, should remain completely separated from the Energy Facilities Siting Council which has the authority under Chapter 617 of the Acts of 1975 to review all proposals for constructing oil refineries and related facilities. The public interest can be protected only if the promotional and regulatory roles are separate. The Council would serve as a check to insure that all appropriate

factors are considered in the proposal. However, if the state does favor refinery development, it is necessary for it to take positive efforts to guide the private developer towards a proposal that will be consistent with state policies and plans. It is far better for the state to have an active role in the decision making process rather than to respond to proposals of individual developers.

FOOTNOTES

1. Federal Engery Administration, *Project Independence Summary* (Washington, November 1974), p. 17.

2. New England Regional Commission, *Petroleum Distribution* Network for New England (Cambridge, December 1974) pages I-69 through I-71.

3. *Ibid*. I-87.

4. Arthur D. Little Inc., Raytheon Co., and Frederick Harris Inc., *A Preliminary Economic and Environmental Study of Alternative Methods of Supplying Petroleum Products to Eastern Massachusetts,* report prepared for the Massachusetts Port Authority, (Boston, July 1973), Volume I, p. I-2-20.

5. Federal Energy Administration, p. 18.

6. *Ibid*.

7. Connecticut Governor's Fact Finding Task Force on Oil Refineries, *Final Report*, (Hartford, January 1975), p. 22

8. J.W. Devanney, "Georges Bank Petroleum and New England Regional Income" paper presented to the Federal Reserve Bank of Boston Conference on New England and the Energy Crisis, (Edgartown, Massachusetts, October 1-3, 1975), p. 18.

9. *Ibid*.

10. Studies include: Arthur D. Little, *Petroleum Development in New England* prepared for the New England Regional Commission, Connecticut Governor's Task Force on Oil Refineries, *Final Report* (Hartford, Conn., January 1975) and University of New Hampshire, the Impacts of an Oil Refinery Located in Southeastern New Hampshire: A Preliminary Study (Durham, New Hampshire, 1974).

11. Arthur D. Little, Vol. III, p. I-18.

12. *Ibid.*, p. I-30

13. *Ibid*., p.I-101.

14. *Ibid.*, p. I-114

15. *Ibid.*, Vol. II, p. III-2.

16. *Ibid.*, p. III-1.

17. Connecticut study, p. 267.

18. Arthur D. Little, Vol. II, p. 11-30 and II-35

19. Arthur D. Little, Vol. III, p. II-81.

20. *Ibid.* p. 268.

21. *Ibid*. p. 269

22. Arthur D. Little, Vol. III, p. II-9.

23. Connecticut Study, p. 271.